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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: C.1.2

Federal Republic of Germany

POSSIBILITIES AND LIMITS OF RURAL CO-OPERATIVE SELFHELP IN DEVELOPING COUNTRIES

By Professor Dr. H.J. SERAPHIM,
Director of the Institute
for Co-operative Research
in the University of Münster,
Federal Republic of Germany

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Possibilities and Limits of Rural Co-operative Selfhelp in Developing Countries

by Professor Dr. H.J. Seraphim
Director of the Institute for Co-operative Research in the University of Münster, Federal Republic of Germany

A country is called underdeveloped if its avarage real per capita revenue is relatively low. In most developing countries the distribution of income is very differentiated, i.e. that part of the population which is of relevance for co-operatives is much poorer than the statistical average shows. Closely connected with the general criterion of a low revenue are: a low rate of saving, a low rate of investment, a small provision with capital, a low intensity of capital and a low productivity of labor. Each of these facts influences disadvantageously the real per capita revenue; the low real per capita revenue is simultaneously cause and result of the underdevelopment. Other criterions of developing countries are illiteracy, little technical knowledges and as a result an unsufficient benefit of the natural resources. The greatest part of the population capable of earning is occupied in the agrarian sector; the structure of agricultural production mostly shows a tendency to single-crop-farming. For there are great differences among the developing countries, especially in the socio-historical aspect, the following essay can not give advise for how to develop countries but it is a basic consideration about the economic problems all developing countries have in common.

In almost all developing countries the agrarian sector dominates, therefore the following functions of the co-operatives are important to improve the productivity of the agriculture:

1. Establishment of a well operating credit system to assign and distribute credits and to raise the wish for savings. The credits have to be assigned to investments.
2. As soon as the small farms buy and sell in the market, the foundation of purchasing and marketing co-operatives is of importance, especially if there is an exportation of agricultural products. Production for the world market always requires the standardization of the quality on a high level and the control of purification, assorting and packing.
3. There must be assistance in using even simple machines to till the land better and thus achieve a higher productivity of labor working in the agrarian sector. To this pertain also instructions about insecticides, fertilizer and irrigation.

In realizing this great member of economically important functions there are many obstacles in developing countries. To be successful in building up co-operatives it must be known which is required as antecedent.

Emanating from the west european experiences the most important preconditions for the foundation of rural co-operatives were as follows:

1. The judicial and economic independence of the member-enterprises (a liberal economic system, liberty of disposition of the individual rural enterprise concerning the formation of production, marketing, borrowing etc.);
2. The economic weakness of the individual enterprise, the awareness of this weak position and the wish to ascend economically by self help. (The weak position of small and medium farms is caused by:
   a) the structure of the agricultural production,
   b) the defensive position against other participants of the market);
3. A leading élite for the management of the co-operatives (Problem of the level of education and of qualification);
4. A guaranted financement of the co-operative enterprise (The co-operative enterprise requires a capital, its members must raise at least some money).

With exception of the economically weak position all these preconditions cannot be realized in the same way as in Europe. The main obstacles to do so are:

1. The low level of education (illiteracy). There is a lack of an economically skilled and open-minded leading élite among the members and of a population being directly susceptible to the ideas of co-operativism. Further there is a lack of rational effort for economic success. Religious and traditional influences as well as the "Idea of Nourishment" stunt the economic development of the greater part of the population.
2. The objective fact of a lack of capital. Beside the insufficient capability of saving if the minimum of existence is scarcely met, neither there is the wish to spare.

The most european co-operatives have been built up under the above mentioned conditions which cannot be arranged in the developing countries during the present phase of development. If the developing countries do not want to renounce the good results of co-operatives concerning the economic development they have to build up them in a way different to that the Europeans did. Because of the insufficient intellectual precondition for a private initiative and because of the lack of capital for the private foundation of co-operatives, it can be only the task of the state to build up co-operatives. Almost without exception the newly founded efficient co-operatives in developing countries have been founded by the state or are part of a public controlled system. After the foundation mostly the state also influences the management in the start period. At the same time the state educates a managerial élite from among the members in order to give the management to the members as soon as possible. But because there are many exceptions from this conception it is necessary in agreement with the ideas of co-operativism to put several basic postulates about the activity of the state concerning the co-operatives.

These postulates arise from the question whether the developing countries succeed in mobilizing on a broad the personal initiative for the community to preserve the basic criterion of the co-operative as an association which is founded and run to further the independent members and which must also preserve the following four principles:

1. Everybody can become a member
2. Democratic self-administration
3. No profit from business which to do the co-operative has been founded
4. Political and confessional neutrality.

Because there live different races in several developing countries these principles are not violated if a co-operative restricts to members of one race, provided that the members of other races have the right to found a cooperative, too.

The principle of democratic self-administration is of particular importance. This principle contains not only the "one man - one vote principle" but also means that there can be no decision against the will of the members of the co-operative. Third persons can give advices, without violating this principle. So for instance officials can influence the co-operative in the decision about:

1. The field of functions of the co-operative (one purpose or multipurpose co-operative);
2. The volume of business (problem of the big co-operative);
3. The collaberation with or the building up on a already existent association (problem of the social infra-structure);
4. The kind of liability;
5. The kind of occupation of the managers (honorary occupation, by-occupation and full-time-occupation)

and about many other problems of the infra-organization.

It is in accordance with the ideas of co-operativism that the state mostly controls the investment of the credits given to the co-operatives. But the state is forbidden to restrict the self-responsibility and the self-administration of the members, which are the essentials of co-operativism.

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The following essay will not give advice for how to develop countries but it is a basic consideration about the economic problems all developing countries have in common. Presumption is set that the rural co-operatives have an important part in the economic growth of developing countries, because the improvement of the agrarian structure is the precondition of a successful industrialization. In this connection it is of decisive importance to arise the initiative of those peoples and to intensify this initiative in the way of co-operative selfhelp.

Presumptions of co-operative activity

1. The judicial and economic independence of the individual enterprise.
   (Liberty of the formation of production, of borrowing, of power to dispose of the ground, of association in co-operatives).

2. The economic weakness of the individual enterprise
   (Economically strong enterprises do not need a co-operation, but the weakness must enable measures of selfhelp).

3. The existence of a great number of economically weak farms
   (Simular weak position, simular structure of production).

4. The awareness of this weak position
   (Understanding of the necessity of associating).

5. Professional qualification of the leaders of the co-operatives.

6. The possibility of financing the co-operatives.

Limits of co-operative activity

1. Often there are only few possibilities of development, therefore there is the necessity of an extended land reform.

2. The economic weak are often so poor that it is very difficult to build up and finance a co-operative.

3. Primitive uniformity of managing extensively excludes differentiations.

4. There is seldom the understanding of the weak position and the wish to ascend economically, because there is seldom a rational-economic thinking, but in place of this metaphysical-religious cohesions.

5. The standard of education is very low (illiteracy), therefore the training of a leading élite is the primary task.

6. The individual enterprises hardly are able to solve the problem of financiation. Here a financial help of the state is necessary; but this help is absolutely forbidden to hurt the primary principles of co-operativisme: selfhelp, self-responsibility and self-determination. The state's help only has to be an initial priming.

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Agenda Item: C.7.2

Brazil

THE CULTIVATION OF THE BRAZILIAN CEDRELA (CEDRELA FISSILIS VEL) IN PURE STANDS WITH PEST CONTROL

By Helladio do AMARAL MELLO,
D. GALLO,
University of S. Paulo,
Brazil

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THE CULTIVATION OF THE BRAZILIAN CEDRELA (CEDRELA FISSILIS VEL.) IN PURE STANDS WITH PEST CONTROL

Helladio do Amaral Mello
D. Callo
University of S.Paulo, Brazil.

1. - INTRODUCTION

The cedrela (Cedrela fissilis Vell) occurs in the natural forests of southern Brazil in the form of scattered trees, which often reach great hights. It is one of the rare species that produces fine woods, presenting fast and satisfactory growth while producing light (density from .450 to .690), durable wood.

The wood of the cedrela is widely used in civil construction, cabinetmaking, vehicle bodies and shipbuilding. As it is well-known in foreign commerce for its outstanding qualities, high prices are being paid for its wood.

Being very susceptible to certain insect pests that can decimate it, the cedrela is permitted to survive by being dispersed within natural forests, surrounded by other arboreal species.

The formation of pure stands was always supposed impossible since concentrated planting increased considerably the possibilities of the incidense of pests.

In recent times, the arrival of highly efficient insecticides permit us to consider its cultivation in pure stands, in an attempt to produce this so widely used wood on an economic basis.

Solis, 1958, shows exceptional results obtained with a species akin, Cedrela mexicana M.G. Roem., grown in Ecuador.

The interest that the possibility of growing cedrela awakens among scientists and land-owners led us to plan and install an experiment which allows studies of pest control along with spacing under local conditions.

2. - MATERIAL AND METHODS

2.1. - MATERIAL

The seeds used to produce the plants required to install the experiment were obtained from selected trees which presented noteworthy qualities as to type, hight and sanitary conditions. The seeds were sown directly in porous clay vases known in Brazil as "torrões-paulistas". They were planted on the final location when four months old.

The soil was plowed and harrowed in preparation for planting. It is a silicate-clay soil with an east-northeast exposure and an average slope of 10%. It is part of the land belonging to the "Secção Técnica de Horticultura" of the "E. S. A. 'Luiz de Queiroz'", whose geographical location is given by its geodesic mark. Latitude: 22° 42' 9" S, Longitude: 47° 38' 8" WG, Altitude: 558, 573 meters.

The climate is subtropical with a hot and rainy summer and cold and dry winter. The average high temperature during the summer (December through March) is 30.2°C and low 18.3°C. During the winter (June through August) the average high temperature is 25.8°C and low 10.3°C. The annual rainfall is from 1200 to 1300 mm.

During December 21,22 and 23 of 1961 the planting was done in open furrows at three-meter intervals.

2.2. - METHODS

A randomized design with split plots was used.

Each treatment intended to control the pests was applied over a plot made

up of three subplots differing in spacing.

2.2.1. - Treatments

Till now, four insecticide applications have been used in pest control, at sixty-day intervals under various forms:

2.2.1.1. - Dieldrex (hexachloro-hepoxi-octahydro-diendomethano-naphthalene) 20% concentration at 1%. The application was done at low volume, using 4.750 liters on the five plots, averaging .950 liters per plot.

2.2.1.2. - Dipterex (dimethyl-hydroxi-trichloro-ethyl phosphonate) .50% concentration at 1%, low volume, using 4.756 liters with an average of 0.951 liters per plot.

2.2.1.3. - Pholidol (dimethyl-paranitrophenylthiophosphate) .60% concentration at 5%, low volume, using 5.242 liters, averaging 1.048 liters per plot.

2.2.1.4. - CONTROL (no treatment)

2.2.1.5. - Gusathion (dimethyl oxo-benzotriazine-methyl phosphoro-dithioate). 20 % concentration at 1%, low volume. 4.700 liters were used, averaging .940 liters per plot.

2.2.2. - SPACING

Each plot contained three different spacings distributed in three subplots:

2.2.2.1. - 3.00 x 1.50 m.
2.2.2.2. - 3.00 x 2.00 m.
2.2.2.3. - 3.00 x 2.50 m.

Each subplot was composed of 63 plants, resulting in 189 plants per plot . the number of replications used was five. In each subplot, the first and last plants of each row were disregarded, leaving 35 plants for study. In the entire experiment, a total of 4.725 plants were used.

2.2.3. - PESTS

The pests considered were:

2.2.3.1. - Hypsipyla grandella (Zeller, 1848) - Lepidoptera Phycitidae. The caterpillars of this species attack young plants and boughs of adult trees, causing the destruction of the terminal buds and the paralyzation of growth. They also attack the fruits and seeds.

2.2.3.2. - Diploschema rotundicolle (Serv., 1834)- Coleoptera Cerambycidae; Macropophora accentifer (Oliv., 1795) - Coleoptera Lamiidae. They are known as "coleobrocas" (borers of the Coleoptera). The larvae are borers of the cedrela.

2.2.3.3. - Oncideres dejeani (Thoms., 1868) - Coleoptera Lamiidae. It is known as a "serrador". The larva is a borer of the cedrela.

The effect of the insecticides cited and the biological study of the pests mentioned including laying seasons, egg locations and their evolution in the larval pupal and adult stages, the number of generations, will all be brought out in this work.

The sprayings have been done every sixty days with a count of the attacked plants.

C O N C L U S I O N S

Thus far, the development of Cedrela fissilis Vell in pure stands has been satisfactory. The average hight obtained by direct measurement of randomly chosen plants, was fifty centimeters eight months after planting.

It must be stressed that the plants vegetated for a period of practically three months since the temperature begins to fall in April, the rains cease nad the leaves fall as winter begins in June.

At each insecticide application, every sixty days, the infested plants were counted. As the experiment was installed during the summer and the plants were sprayed only thirty days afterwards, the occurrence of pests attacking the plants has not been ascertained. The climactic conditions of the approaching winter were not very favorable for the development of pests. For this reason, the incidence of attack is expected to begin next October when vegetative growth begins due to the then caracteristically hot and humid weather here.

S U M M A R Y

The Brazilian cedrela furnishes one of the most valuable woods among native species.

It is fast growing, produces seeds regularly and can also be propagated vegetatively; however, when grown in pure stands it has been limited by the pest which attacks it (Hypsipyla grandella Zeller). In natural forests it occurs as isolated trees in which way it can survive.

An experiment has been organized on land of the "Escola Superior de Agricultura "Luiz de Queiroz" using randon designs subdivided in blocks. These blocks represent the treatments to be applied in the pest controle which comprise three sub-blocks, each with a different spacing of plants. The treatments in the blocks are represented by the insecticides used: Dieldrex, Diptherex, Pholidol, Gusathion and control. The spacings used in the sub-blocks were: 3.00x1.50 m; 3.00x2.00 m.; and 3.00x 2.50 m. The number of plants per sub-block was 63 in order to retain 35 plants for analysis.

The number of replications was 5 and the experiment involved 4.725 plants. It is an experiment destined for good response if the results are favorable, which is to be expected considering the pest controle achieved so far.

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The Brazilian cedrela furnishes one of the most valuable woods among native species.

It is fast growing, produces seeds regularly and can also be propagated vegetatively; however when grown in pure stands it has been limited by the pest which attacks it: Hypsipyla grandella (Zeller, 1848) - Lepidoptera Phycitidae; Diploschema rotundicolle (Serv., 1834) - Coleoptera Cerambycidae; Oncideres dejeani (Thoms., 1868) - Coleoptera Lamiidae; Macropophora accentifer (Oliv., 1795) - Coleoptera Lamiidae.

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The number of replications was 5 and the experiment involved 4.725 plants. It is an experiment destined for good response if the results are favorable, which is to be expected considering the pest control achieved so far.

CONCLUSIONS - Thus far, the development of Cedrela fissilis Vell in pure stands has been satisfactory. The average hight obtained by direct measurement of randomly chosen plants, was fifty centimeters eight months after planting.

It must be stressed that the plants vegetated for a period of practically three months since the temperature begins to fall in April, the rains cease nad the leaves fall as winter begins in June.

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Agenda Item: C

United States of America

ORGANIZING FOR AGRICULTURAL DEVELOPMENT

By Forrest F. HILL,
Vice President,
The Ford Foundation, New York,

Arthur T. MOSHER,
Executive Director,
The Council on Economic
and Cultural Affairs, Inc.,
New York

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ORGANIZING FOR AGRICULTURAL DEVELOPMENT

Forrest F. Hill, Vice President
The Ford Foundation, New York

Arthur T. Mosher, Executive Director
The Council on Economic and Cultural Affairs, Inc., New York

Introduction

1. There are two crucial points requiring attention in organizing for agricultural development. One is the individual farm or holding. The other is the wider economy as it affects agriculture.

2. This paper will be primarily concerned with the first of these, with emphasis upon those aspects of organization that bear most immediately upon the production decisions of farm operators. Attention will be focused upon the kinds of jobs that need to be done if substantial and sustained increases in agricultural production are to be achieved and the more difficult problems of organizing to do them. Scant attention will be given to forms of organization or to administration.

3. Back of those activities that have an immediate bearing upon farmers' production decisions are a host of supporting activities in the wider economy that are essential to agricultural development -- provision of transportation networks; general and technical education; health facilities; appropriate patterns of land settlement, tenure and tenancy; irrigation facilities; appropriate tax, credit, fiscal and monetary policies; and many others. Although each of these influence agricultural development, directly or indirectly, and to a greater or less extent, because of space limitations we shall do no more in this paper than recognize their importance. We shall concentrate on what seems to us to be the central problem of organizing for agricultural development, namely, broadening and making attractive the alternatives available to each farm operator in the direction of increasing farm output.

Basic Considerations in Organizing for Agricultural Development

4. Agricultural production is not a mechanical process but one of facilitating biological growth under almost infinitely varying conditions. It is very different from factory production in which it is possible to control within narrow limits the quality and quantity of each input and the environment in which the production process takes place to produce, day in and day out, a highly standardized product in predetermined amounts. Instead, agriculture is carried on in varying climates under fluctuating weather conditions, drawing upon variable supplies of plant nutrients and soil moisture, using crop varieties of differing genetic potential and with crops and livestock subject to diseases, pests and other hazards.

5. On most of the cultivated lands of the earth, there are variations in soils, available plant nutrients, soil-water relationships, and sunlight, air and soil temperatures during the growing season, not only among regions and areas within regions but in greater or less degree from farm to farm, field to field, and even within fields. The north and south slopes of a single hill may be best adapted to different crops or require a different set of production practices for best results. The intricate pattern of land use on individual farms in Japan illustrates close adjustment of agricultural production to microdifferences in factors affecting plant

growth. Fields at different distances from villages in North India currently differ widely in soil fertility. They are planted to different crops and cultivated with differing intensity.

6. Thus, it is characteristic of the production process in agriculture that, in technical terms, the quality and quantity of most inputs is variable and joint costs and joint products are more characteristic than in many types of industrial production.

7. What this means for agricultural development is that standardized recommendations for wide areas of agricultural land are seldom if ever justified. Instead, the essence of maximizing agricultural production is to find the best use for individual fields and plots, modifying each in such ways as are necessary and economically feasible to increase the quantity and improve the quality of the product.

8. Although the basic process in agriculture is the management of biological growth, agricultural production is an economic activity. In societies in which the farm operator (whether owner, tenant or hired manager) makes production decisions the individual farm or holding is the unit for which costs and returns must be compared whether in monetary or non-monetary terms. It may be that the real cost of using a new production technique is decreased leisure or lowered social status if the cultivator is considered by his neighbors to have violated his role in society by breaking a long-established tradition. An increased harvest does not constitute increased income if the cultivator is forced by social custom to share it through feasting or to support relatives rather than being allowed by local custom to sell it. Or an increased harvest, beyond family and local needs, may not represent increased returns if there is not a market for it at a remunerative price.

9. The key to agricultural development is to make it possible and attractive for the operator of each farm or holding to change practices in ways that will increase production on a sustained basis. It is on the alternative combinations of practices available to the individual operator and the potential rewards associated with these alternatives that attention must be focused if substantial and sustained agricultural development is to be achieved.

10. It is important to recognize, and never forget, that agriculture is an activity of human beings, of people. No matter what the form of social or economic organization, it is people who make decisions about the management of farms, who learn new skills, adopt new practices, till the land and manage the livestock. They provide the labor but they are much more than laborers. They are human beings -- individuals -- who at the same time are members of communities, societies and cultures and who derive much of their satisfaction in life from the degree to which they are accepted, respected and loved within those groups.

11. In organizing for agricultural development we are trying to encourage and facilitate such behavior by men and women as will result in their producing more agricultural products while recognizing and respecting the fact that few of them are interested in production for the sake of production but only as it serves ultimate values and goals held by them or by the social groups of which they are members.

12. In this era of national planning, we have grown accustomed to thinking in national terms and national programs. This is important and has its place. But we must never allow the national view, important as it is, to cause us to overlook those characteristics of agriculture that make imperative effective local integration of efforts to increase production and substantial adaptation of development programs to meet varying sets of local conditions.

13. What has been said applies almost equally in regions where agriculture is still largely traditional, in regions where it is in the transitional stage of development,

and in places where agriculture has entered the commercial stage. In the remainder of our paper, however, we shall center our attention on organizing for agricultural development at the early transitional stage. This stage has two important characteristics: First, it is the stage in which farmers' decisions are based less and less upon tradition and more and more upon rational choice from among alternatives. Second, it is the stage when more and more purchased requisites are used in agricultural production.

14. If, at the early transitional stage, a program to increase agricultural production is to be successful, effective organization and follow-through is essential in three areas:

(a) First, provision must be made for developing locally-tested combinations of improved practices which, if adopted by farmers, will increase production on their farms;

(b) Second, production supplies and equipment of the kinds and quality farmers must have if they are to put recommended combinations of practices into effect must be locally available when needed;

(c) Third, individual farmers must be convinced that the recommended practices will in fact increase production on their farms and that it is to their advantage to adopt them.

Activities in these three areas must be carefully coordinated in a single, integrated program if sustained development at a satisfactory rate is to be achieved.

Locally Tested Combinations of Practices

15. Economic increases in agricultural production seldom result from the adoption of a single improved practice. Substantial and sustainable increases in agricultural production usually depend upon the use of a combination of improved practices including use of improved crop varieties; use of chemical fertilizers and other measures to insure an adequate and balanced supply of available plant nutrients; practices designed to provide suitable water-air relationships in the soil; and plant protection measures.

16. Since there are usually significant variations among farms, and even among the fields of a single farm, in soils, topography, available supplies of plant nutrients, water relations, air and soil temperature, sunlight, etc., it follows that not one but many different combinations of "inputs" must be used in a single community and even on different fields of a single farm if returns from land, labor, purchased requisites and other factors are to be maximized. Seldom, if ever, is a single set of recommended practices suitable for use without adjustment throughout an area of appreciable size. Such a set of "standard" recommendations is like the Army uniforms in World War I were said to be, designed to fit the "average" man with the result that they were too big for half the Army and too small for the other half. There is, of course, a limit to the number of sizes of clothing it is feasible to manufacture, whether for soldiers or civilians. The individual either has to be satisfied with an "approximate fit" or get a local tailor to make the necessary adjustments. So it is with agricultural practices. Even the recommended practices that constitute the "best fit" for a particular farm usually require some adjustment if the best results are to be obtained, especially when economic considerations and the operator's management capabilities and financial position are taken into account.

17. A large body of scientific and technical knowledge exists that makes possible the development of locally-adapted practices that, if properly applied, will increase agricultural production by substantial amounts in the developing countries. Unfortunately, political leaders, government administrators and members of the public with little knowledge of agriculture sometimes fail to distinguish between this general body of

knowledge and its application to specific situations. The scientific principles and the art of plant breeding are highly developed. It may still remain to apply the principles and the art to the development of varieties of wheat, corn or rice suited to particular conditions of soil, climate, consumer tastes, etc.

18. It should not be overlooked that even in countries with highly developed programs of agricultural research, while some research workers are adding their bit to the world's store of basic knowledge, by far the greater number are engaged in applying known principles to the solution of local problems. They are engaged in trying to develop improved practices that, when appropriately combined, will better meet the needs of farmers in particular situations.

19. Few newly developing countries have the necessary financial resources or trained personnel to develop a full-fledged system of central laboratories and research stations, experimental farms and demonstration fields within a short span of years. Too often under such circumstances the tendency is to establish central laboratories and research stations to which the scientific staff retreat, there to engage in long-term station-based research when the pressing need is for field studies and diagnosis of key problems retarding agricultural development and for scientific and technical work designed to find solutions to them. Laboratory and central station research is needed in developing countries. The question, however, is not whether such research is needed but how to make the best use of limited scientific and technical personnel and other scarce resources in the early stages of transition from a traditional toward a more highly commercialized agriculture.

20. Field trials and test demonstrations supervised and evaluated by research scientists have two special advantages at this stage. First, they take research scientists into the field where they come into direct contact with production problems, members of the agricultural advisory staff and practicing farmers. This usually proves useful all around, particularly in providing for the kind of "feedback" to central research stations and laboratories that is necessary if successive roadblocks to increased production are to be systematically attacked as they appear. Second, observation of local field trials and test demonstrations by farmers can play an important role in their developing a rational scientific attitude toward farming. In observing local testing and field trials farmers may learn the basic steps of observation, measurement, comparison of results and drawing of conclusions that are the fundamentals of rational thinking and science-based agriculture.

Production Requisites

21. Efficient and timely production and distribution of the requisites of agricultural production is a basic requirement in the shift from a traditional toward a commercial agriculture. This is too often overlooked in the early years of the transitional stage and too little effort and too few resources devoted to the manufacture (or importation) of the production supplies and equipment required by a changing agriculture. The first requirement is to get "requisites" (purchased equipment and supplies) of the required kind and quality produced or imported. This must be followed by measures to improve distribution, reduce costs, and assure the quality of the product as it reaches the farmer.

22. The purchasable inputs or requisites of agricultural production fall into four principal groups: (1) improved seeds; (2) fertilizers; (3) pesticides; and (4) implements, handtools and sources of mechanical power. Seeds better than those now in use by most farmers are already available locally in many places. In traditional and early transitional agriculture, there is considerable variation in the productivity of seeds customarily sown by different farmers. In addition, few farmers systematically collect, save and use the best of their own seed. Consequently, the first and easiest step in the provision of better seed is to find the best of the seeds already

in use in each locality and to introduce more systematic seed selection and storage by individual farm operators.

Production

23. All production requisites other than seeds -- fertilizers, pesticides, implements and tools, and sources of mechanical power -- must be manufactured. They differ, however, in whether they can be manufactured locally, using present technology; whether they can be efficiently manufactured in many small, widely scattered plants using new technology; or whether they can be efficiently manufactured only in centralized plants of large capacity. Improved implements and tools often can be manufactured locally by rural artisans using present technology. Some pesticides, and many tools and implements, can be manufactured in small-scale plants using new technology. Fertilizers ordinarily require large-scale manufacture in centralized plants if the operation is to be efficient.

24. Only two of the four principal classes of requisites needed for increased agricultural production, namely, fertilizers and pesticides, may require substantial amounts of foreign exchange to finance imports at the beginning of a program for agricultural development. These requisites are so important to agricultural development that sufficient foreign exchange should be made available to import as much of each as farm operators are ready to buy. The great importance of fertilizers and pesticides, and the demand their importation places on available foreign exchange means that the establishing of fertilizer and pesticide manufacture should have high priority in plans for industrialization in every country of substantial size in which agriculture is a major industry.

25. The provision of improved seeds normally will make very little demand on foreign exchange. Implements, tools and sources of mechanical power can make high demands on foreign exchange if allowed to do so but in most cases a country is better advised in the early stages of development to use the implements, tools and sources of power it can produce domestically. There are, of course, exceptions to this general statement.

Salability

26. Production requisites have four qualities inherent in themselves that significantly affect salability to farm operators: (1) technical effectiveness; (2) dependability as to quality; (3) availability when needed; and (4) price. When farm operators fail to purchase requisites in "planned" amounts, officials, administrators and others frequently explain the failure in terms of the "backwardness" or "conservatism" of farmers or because of "lack of credit." These factors may be involved but before passing such judgments it is important first to examine what was offered and on what terms.

27. The first quality a requisite must have to be salable is technical effectiveness. Is the "improved" seed really better? Too often, yield per acre at the central research station has been the principal factor taken into account in recommending its use. Unless the seed has been locally tested, differences in soils, available supplies of plant nutrients, water relations and microclimates may be such that the "improved" seed yields little or no more than varieties already in common use. If the growing season is significantly different from that at the central station where the new variety was developed, its use may expose the farmer's crop to greater than normal danger of damage by frost, disease, insects or birds because it ripens at a different time than local varieties. If the crop is used chiefly for local consumption, the taste or cooking quality may be sufficiently different to make it unpopular. In the case of fertilizers, differences in local soils, unless adjusted for, may result in yields quite different from those obtained on the central experimental farm.

28. Whatever the causes for local differences in technical effectiveness, only carefully planned and supervised local testing can assure that requisites recommended and

offered for sale really represent increased production opportunities.

29. A second influence affecting salability is the purchaser's confidence in the genuineness and purity of the item offered. Even tools and implements of inferior quality are not easily identified in the market place. For this reason, a prime requirement to widespread and repeated purchase of production requisites is sufficiently careful control of quality at all steps in the production and distribution process that farm operators develop confidence in their sources of supply.

30. The third factor affecting the salability of requisites is availability when needed. If a particular crop must be sown in early April, improved seed that arrives at the local distribution center on April 20th is useless and will go unsold since farm operators have already had to make other arrangements. If the seed is to be treated before sowing to control disease, the fungicide will also go unsold. In most agricultural operations, timing within a relatively narrow range has an important effect on yields and for requisites to be useful, and therefore salable to farm operators, they must be available when needed.

31. The fourth factor affecting salability of requisites to farm operators is price. It is important, but it is perhaps the least important of the four. Even a low price will not attract purchasers if the requisite is not technically effective, if its quality is uncertain, or if it is not available when needed. On the other hand, farmers have again and again demonstrated their readiness to pay premium prices for requisites that are effective, of reliable quality, and available on time.

Distribution

32. In a number of developing countries, arranging for the production and distribution of production requisites has proved to be a major bottleneck in programs to increase agricultural output. Even when the necessary requisites have been imported or manufactured domestically, existing facilities have not been geared to the job of distribution.

33. In practically every newly developing country, private commercial channels for the marketing in local areas of many articles in wide demand are already well established. However, because of the widespread, largely untested assumption that distribution through private merchants is more costly and less efficient than through governmental or cooperative agencies, the usual pattern is to set up new agencies to distribute production requisites. It would seem justifiable to recognize that the present merchants comprise a pool of experienced, trained manpower no less than do the present cultivators of land. It would appear, therefore, that advisory services in newly developing countries to help present merchants introduce the changes necessary to make the distribution of agricultural production requisites efficient and satisfactory might be worthwhile.

34. What is important, whether distribution is through governmental, cooperative, or private channels, is that there be no gaps in the system from importation or manufacture to village outlets within easy reach of farm operators. Manufacture, transportation, storage, and village retailing all must be articulated whether handled by the same or by different agencies. And at the village end of the supply line the amounts of various requisites stocked must be related to the recommendations of extension or other farm advisory services.

Production Credit

35. Even if locally-adapted combinations of improved practices are available, farmers are ready to adopt them, and the necessary requisites are at hand, the purchase of requisites still has to be financed. In some cases this can be done from savings. In others it will be necessary to borrow.

36. It is widely believed that new agencies to make production credit available to farmers are a necessity in the early transitional stages of agricultural development. Several recent studies have indicated that even though interest rates are high, lack of special credit facilities may not stand in the way of the purchase of production requisites provided tested practices that offer attractive prospects of increased income are available and that requisites of proved effectiveness are for sale at fair prices. This is not to say that improved credit facilities are not desirable and needed. It does point to the fact that the first requirement is for improved practices that produce results and the requisites necessary to put them into effect. The failure of farmers to adopt improved practices on a wide scale is often ascribed to lack of organized credit facilities when the real reasons lie deeper.

37. Although lack of credit on favorable terms may not be a barrier to agricultural development, it is clear that a well-organized credit system that functions effectively -- whether private, cooperative, governmental or a combination of the three -- greatly facilitates development. More and more credit is used and credit therefore becomes increasingly important as agriculture moves from the traditional through the transitional into the commercial stage of development.

38. In the early stages of development, lenders usually rely heavily upon pledged collateral or the reputation of borrowers as security for their loans. This penalizes the farmer without collateral but who is progressive and capable of repaying a loan from the production of his farm. An important first step in developing an effective production credit system is to begin to make loans based on an analysis of the borrower's ability to repay his loan from increased farm income rather than the possible liquidation of pledged collateral.

39. A second important step is to adjust the term of the loan to the normal production and marketing cycle. Production loans should not fall due until a reasonable period after the marketable product is in hand. Otherwise the borrower is placed in a position where the lender can bring pressure upon him to sell immediately at harvest time when prices are often low, perhaps to the lender or someone he designates. This works to the disadvantage of the farmer, decreases his incentive to borrow to increase production and works counter to programs to encourage orderly marketing.

40. Like any other production requisite, credit must be available when needed if it is to influence farmers' production decisions. A loan applied for on March 15 and approved May 1 to finance a crop that must be planted not later than April 10 is not likely to speed the adoption of improved practices.

41. Cost is a factor affecting farmers' use of credit just as cost affects their use of other production goods and services. As previously indicated, however, the cost of credit may not be the critical factor determining the extent of its use. This being the case, the question of whether or not to subsidize interest rates and if so to what extent is a matter for careful analysis and consideration.

Inducing Farmers to Adopt Improved Practices 1/

42. In most countries the individual farm operator, whether owner, tenant or hired manager, is the key decision-maker in agriculture. If improved practices are to be adopted he must be trained to use and persuaded to adopt them.

1/ We have drawn extensively upon an unpublished memorandum prepared by Dorris D. Brown, Agricultural Economist, The Ford Foundation, New Delhi, in the preparation of this section.

43. Observations in a number of countries in which agriculture is in the early stages of transition, suggest that within the limits of their knowledge and the alternatives open to them farmers in these countries are as rational in their economic decisions as farmers anywhere. They respond to price differences. They are affected by the share of the harvest they can retain. They operate within the limits of their knowledge. They also respond, of course, to the prevailing social values of the groups in which they live.

44. In most newly developing countries illiteracy in rural areas is high, ranging from 60 to 90 per cent or even higher. This does not mean that farmers lack intelligence. It does mean that their knowledge of underlying factors affecting plant and animal production is limited as is their ability to calculate probable costs and returns as a basis for selecting from among a number of alternatives. A recent Indian survey reports that the number of improved practices adopted by individual farmers was directly and significantly related to levels of educational attainment. This suggests that although it may not be too difficult to get farmers to adopt a single, simple practice in areas where illiteracy is high, achieving widespread adoption of combinations of improved practices may prove to be slow, at least in the beginning. It will become easier and more rapid as farmers become, first, literate, and then better and better educated, and as extension and research personnel become more and more competent.

45. There are three important means by which change to improved farm practices can be accelerated. One of these is the type of education usually associated with the term extension education. A second way to provide greater inducements to farmers to adopt improved practices is to protect them against undue economic risks of innovation by establishing price floors for important agricultural products so that they need not fear disastrous price declines as production increases. A third way is to devise conditions of tenure and tenancy that assure farmers of reasonable security of tenure and a fair share of such increases in production as may result from the adoption of improved practices. At the same time, these arrangements need to be such as will encourage land improvements and other medium- and long-term types of capital investment by landowners. Tenant farmers who receive only 50 to 60 per cent of the added yield and must pay all the added cash costs may not feel they are likely to gain enough from adopting improved practices to justify the risks involved.

46. Research and advisory services in many developing countries are not such as to win the confidence of farmers. Research workers, few of whom have a farm backgound, spend a large part of their time in laboratories or central research stations and little time in the field. They have little first-hand knowledge of production and related economic problems confronting farmers and contribute little toward their solution. Advisory services are frequently understaffed, often at the village and farm level by persons without farming experience and only limited technical knowledge gained in training courses extending over periods of six months to two years. Acting under instructions from above, they can tell farmers what to do but seldom can they tell them why or show them how. Few are competent to advise individual farmers how to adjust recommended combinations of practices to fit their particular situations or help them develop medium- or long-term farm plans based upon estimated costs and returns from several alternative possibilities. Because communication with research scientists is usually irregular and poor, members of advisory services seldom can be of help in dealing with new and unexpected problems.

47. Yet, despite all of the handicaps confronting them, some village-level workers and farm advisers do surprisingly well. An important problem in the early stages of developing an advisory service is bringing the performance of the many to the standards of the best, at the same time seeking to raise the general level of technical knowledge and competence.

A Strategy for Agricultural Development

48. Obviously, a comprehensive strategy for agricultural development in a newly developing country must be much broader than the needs discussed in this paper. Such a comprehensive strategy must include attention to optimum investment in roads and transport, improvement of arrangements for marketing farm products, measures for public health and general education, determination of appropriate patterns of land tenure and taxation, and to many other aspects of the total economy.

49. The burden of this paper is to high light the activities most essential to improving managerial decision-making and husbandry practices by individual farm operators, and to urge the absolute necessity of the coordination of these at the local level. Far too frequently, the all-important local testing of single improved practices and of combinations of these receives little or no attention. Extension education is frequently uncoordinated with local testing, with the production and distribution of requisites, and with production credit.

50. We suggest that the obvious starting point in coordinating these activities in each agricultural area is in the arrangements made for local testing and for extension education. Widespread demonstrations of the results of local testing can be an effective addition to extension practices.

51. To this basic combination of local testing and extension there must be added adequate provision for the supply and financing of production requisites. These are sufficiently different from local testing and extension education that they are usually best handled by separate staffs. But close coordination between these and extension education and local testing is imperative. This can be achieved within each agricultural area by making those responsible for all of these activities locally responsible to a single local administrator of agricultural development.

52. Each newly developing country faces a seeming conflict between economic considerations, on the one hand, and social and political considerations, on the other, in its program for agricultural development. Economic considerations argue for concentration of scarce resources, including skilled manpower, on increasing agricultural production in those regions where both natural and cultural factors are most favorable. Social and political considerations frequently argue for spreading development resources fairly evenly over the whole rural population.

53. The conflict between these may be more apparent than real. For what is imperative in the first instance is to find and develop a pattern of local coordination of the activities necessary to improve managerial decision-making and husbandry practices by individual farm operators. Except, perhaps, in the case of very small countries, this cannot be done on a nationwide basis in the first instance; it must be done first in a few selected areas. In view of the economic consideration of increasing total agricultural output as rapidly as possible, these first experiments in adequately supported and coordinated local programs should be in areas where natural and cultural circumstances are most favorable. A pattern of operations, once determined, tested and established, can then be spread as rapidly as resources (particularly of trained manpower) will permit, to more and more regions of less and less initial agricultural potential, until the social and political considerations, which are of equal importance in the long run, are satisfied.

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: C

United States of America

ORGANIZING FOR AGRICULTURAL DEVELOPMENT

By Forrest F. HILL,
Vice President,
The Ford Foundation,
New York,

Arthur T. MOSHER,
Executive Director,
The Council on Economic
and Cultural Affairs, Inc., New York

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

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ORGANIZING FOR AGRICULTURAL DEVELOPMENT

Forrest F. Hill, Vice President
The Ford Foundation, New York

Arthur T. Mosher, Executive Director
The Council on Economic and Cultural Affairs, Inc., New York

1. There are two points on which attention must be focused in organizing for agricultural development. One is the individual farm or holding. The other is the wider economy as it affects agriculture. This paper is primarily concerned with the first of these.

2. In most countries the individual farm operator, whether owner, tenant or hired manager, is the key decision-maker in agriculture. If agricultural production is to be increased, he must be induced to make the decisions and take the steps necessary to increase it. The key to agricultural development is to make it possible and attractive for the operator of each farm or holding to change his farming practices in ways that will increase production on a sustained basis.

3. If agricultural production is to be substantially increased, three conditions must be met:

(a) First, provision must be made for developing locally-tested combinations of improved practices which, if adopted by farmers, will increase production on their farms;

(b) Second, production supplies and equipment of the kinds and quality farmers must have if they are to put improved practices into effect must be locally available when needed;

(c) Third, individual farmers must be convinced that recommended practices will in fact increase production on their farms and that it is to their advantage to adopt them.

4. On most of the cultivated lands of the earth there are variations in soils, available plant nutrients, water-air relationships in the soil, sunlight, and air and soil temperatures during the growing season, not only from area to area but in greater or less degree from farm to farm and even from field to field. Because of these variations, standardized recommendations for large areas of land are seldom, if ever, justified. What is needed are locally-tested combinations of improved practices and assistance to farmers in adapting recommended practices to their individual situations, taking into account physical factors, economic considerations and the farmer's financial position and managerial ability.

5. If agricultural production is to be increased, production requisites of the kinds and quality required to put improved practices into effect must be available. If they are to be widely used, requisites must be (a) technically effective,

(b) dependable as to quality, (c) available locally when needed, and (d) fairly priced. Too often in planning agricultural programs, too little attention and too few resources are devoted to the production and distribution of production requisites.

6. As agriculture moves from the traditional through the transitional and into the commercial stage, credit is used more and more to finance production and a well-organized production credit system becomes increasingly important. If the system is to serve farmers most effectively it is important that: (a) Loans be based primarily upon analyses of the ability of individual borrowers to repay from farm income rather than upon their ability to pledge collateral; (b) the periods for which loans are made be sufficiently long to permit borrowers not only to produce the crop or livestock products being financed but to market them in an orderly manner; (c) credit be readily available when needed; and (d) farmers be able to borrow at reasonable cost.

7. Inducing farmers to adopt improved practices almost always depends upon not one but a combination of actions and activities integrated as part of a single program. Such activities usually include programs to develop locally-tested combinations of improved practices; educational programs and local demonstrations of improved practices; and programs to make suitable production requisites, including credit, available when needed. In addition, it may be necessary in some cases to establish price floors for the more important agricultural products and modify land tenure systems in appropriate ways. Failure to take effective action in one field may largely nullify actions taken in others. All of the principal inhibiting factors must be reduced or eliminated if agricultural production is to proceed on a sustained basis.

8. It is of the greatest importance that all activities designed to make it possible for farmers to increase production and attractive for them to do so be effectively coordinated at the local level. The first step in the development of a program to increase agricultural production ordinarily should be to organize, in a limited number of areas, locally-coordinated activities to improve managerial decision-making and husbandry practices by individual farm operators. After testing the program in a limited number of areas, it can then be expanded throughout the country as manpower and other resources become available.

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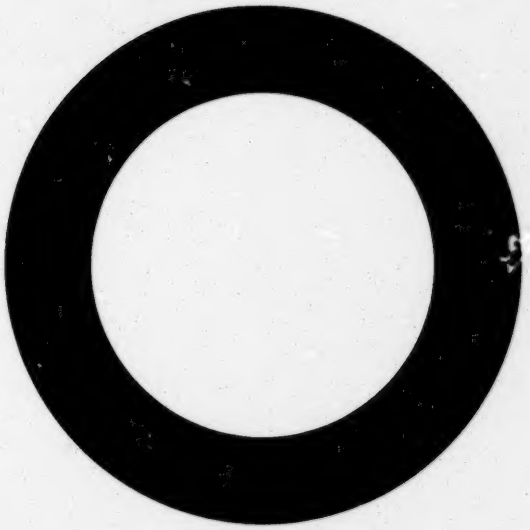

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CONFÉRENCE DES NATIONS UNIES
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Point de l'ordre du jour : C.4.3

Madagascar

LE SISAL A MADAGASCAR : LES PROBLEMES POSES PAR CETTE CULTURE ET LES RESULTATS ACQUIS PAR LE CENTRE DE RECHERCHES SISALIERES DU MANDRARE

Par S. CRETENET,
Ingénieur à l'IRCT

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LE SISAL A MADAGASCAR : LES PROBLEMES POSES PAR CETTE CULTURE ET LES RESULTATS ACQUIS PAR LE CENTRE DE RECHERCHES SISALIERES DU MANDRARE.

par S. CRETENET, Ingénieur à l'I.R.C.T.

INTRODUCTION -

Au début du siècle le sisal était cultivé à Madagascar au Nord de l'Ile dans la région de Diego-Suarez et dans le Sud-Ouest, près de Tuléar. Des conditions de sol inadaptées et des difficultés de main-d'oeuvre dans le premier cas, une écologie insuffisamment favorable dans le second ont entraîné la disparition des exploitations.

Au cours des années quarante, le sisal s'implantait à son tour dans la Vallée du Mandrare, en plein Androy à l'extrême sud de Madagascar.

Tout récemment, la culture a commencé à se développer dans l'Ouest, près de Morondava avec 1.000 ha plantés, 400 ha en exploitation et un programme de culture de 3.000 ha.

La région du Mandrare constitue donc actuellement la seule zone importante pour l'exploitation du sisal à Madagascar. Sur 25.000 ha ouverts à l'exploitation 18.500 ha sont déjà plantés, le rythme des extensions étant de 1.000 ha/an et celui des renouvellements sensiblement de la même importance. La zone sisalière du Mandrare n'a donc pas encore atteint son équilibre d'exploitation.

L'exploitation, sous la forme industrielle, est fortement mécanisée. Elle occupe à longueur d'année 4.500 ouvriers pour une puissance installée de 6.000 CV. La production, de 13.500 T. en 1961, devrait atteindre 16.000 tonnes en 1962. Les disponibilités en main-d'oeuvre constituent le point sensible du programme d'expansion de la production.

En définitive l'on se trouve en présence d'une industrie agricole pour laquelle la teneur en fibre de la matière première ainsi que l'économie et la productivité de la main-d'oeuvre constituent les préoccupations primordiales et constantes.

Le Centre de Recherches sisalières du Mandrare crée en 1951 au coeur de la zone de production a pour but d'étudier l'accroissement de production et de productivité dans le cadre d'une économie de main-d'oeuvre.

LES PROBLEMES

1. Détermination des zones de culture - D'une manière générale, les études sur le Centre ou les essais extérieurs doivent permettre de conseiller la mise en culture ou non d'une zone d'extension. En outre elles conduisent à une estimation des rendements et de la durée du cycle, paramètres nécessaires à l'établissement d'un planning d'exploitation.

2. Analyse des facteurs de production - L'expérience montre que le rendement à l'unité de surface ne constitue pas un critère suffisant pour les études de productivité. Son incidence sur le prix de revient des postes de récolte et d'usinage oblige à faire intervenir le poids de fibre par feuille.

3. Problèmes particuliers à une exploitation - Le rapport entre la superficie exploitable et la puissance installée peut conduire à l'accroissement de l'intensité de l'exploitation : l'expérimentation permet de déterminer les modalités de culture et d'exploitation à employer.

Par ailleurs, l'établissement des plannings d'exploitation et leur réajustement à la suite d'aléas font appel aux résultats obtenus sur la station de recherches et si nécessaire aux techniques particulières de hautes densités x coupe unique mises au point à cet effet.

De plus, le Centre de Recherches, par son organisation, se révèle particulièrement apte aux essais de techniques et de matériels nouveaux.

Enfin à l'aide de son matériel de défibrage expérimental, le Centre effectue des Contrôles de rendement à la demande des exploitants.

4. Choix de la plante - La seule espèce cultivée est l'Agave rigida sisalana. La station de Recherches de Mlingano au Tanganyika a obtenu des résultats prometteurs à partir du croisement d'A. Augustifolia x A. Amaniensis. Les quelques mutations observées à l'intérieur du clone A. sisalana cultivé n'offrent aucun intérêt pratique. L'absence de variabilité à l'intérieur de l'espèce A. sisalana voue actuellement à l'échec tout espoir d'amélioration par les méthodes classiques.

LES SOLUTIONS ACTUELLES -

1. Données écologiques des zones sisalières - Une étude pédologique couvrant le Centre de Recherches et l'ensemble de la zone sisalière a été réalisée par les soins de l'I.R.S.M. . Elle permet d'assurer avec précision l'extrapolation des résultats obtenus sur les trois grandes catégories de sols (Alluvions, Sables roux, Sols dégradés) réunis sur le Centre de Recherches et représentant la grande majorité des sols cultivés en sisal dans la région. Une carte au 1/50.000° a été dressée et complétée par des études détaillées au 1/10.000° dans les zones hétérogènes.

L'eau constituant le facteur limitant, un réseau pluviométrique dense a été réalisé avec la collaboration des exploitations. Ce réseau fonctionnant depuis 10 ans a montré de grandes variations dans les précipitations suivant les lieux et au cours des années. Le travail en cours recherche à dégager les corrélations existant entre les conditions climatiques et l'émission foliaire. Ces informations sont de la plus haute importance car elles doivent permettre de suivre les variations des réserves en fibre dans les champs et d'établir les plans de campagne d'une façon plus rationnelle et plus précise.

2. Techniques culturales -

a) Préparation des sols - Ce problème a fait l'objet de deux séries d'essais distinctes, conduites l'une et l'autre sur alluvions et sables roux.

- Préparation des sols d'extension en 1° culture de sisal
- Préparation des sols en renouvellement de cycle.

Pour la <u>première culture sisal</u>, en alluvions, le labour l'a emporté sur le sous-solage, ce dernier étant identique au témoin et le labour suivi de sous-solage ne s'est pas montré supérieur au labour seul. En sables roux, labour, sous-solage et labour + s... ...lage ont donné des résultats équivalents. En alluvions le labour a doublé le rendement des deux premières coupes par rapport au témoin et en sables roux, il l'a augmenté de 50 %. Ces essais ont permis de mettre fin à la controverse que soulevait le problème du labour en 1° cycle sisal.

<u>En renouvellement de cycle</u>, la présence du système racinaire et des résidus de la récolte précédente pose des problèmes nouveaux : L'expérimentation en cours compare enfouissement, brûlage et évacuation des résidus de récolte (stipes) ainsi que le retournement ou non du système racinaire. L'essai est encore trop récent pour permettre de tirer des conclusions. Il se rattache d'ailleurs aux problèmes plus généraux du bilan et de l'évolution de la matière organique. Dans le même temps une technique d'enfouissement des déchets à l'échelle de la grande exploitation a été mise au point.

b) <u>Matériel végétal de plantation</u> - Bulbilles et drageons ont fait l'objet d'essais comparatifs. Repiqués dans des conditinns normales, les uns et les autres donnent des rendements indentiques. Toutefois, en conditions défavorables, les pertes sont 10 fois plus élevées avec les drageons qu'avec les bulbilles. Des essais entrepris pour rechercher les causes et les remèdes à cette différence de comportement ont amené le Centre à conseiller l'introduction d'une phase de déshydratation avant plantation des drageons lorsque les conditicns de reprise sont défavorables (humidité insuffisante, température élevée). Une étude économique montre que pour un prix de revient à l'hectare légèrement supérieur le renouvellement par bulbilles présente de sérieux avantages en année normale et constitue une assurance en période de sécheresse.

c) <u>Entretien des pépinières</u> - La généralisation de l'emploi des pépinières posait un problème d'entretien difficile à résoudre par voie manuelle ou mécanique : Le sarclage à la main demande des quantités de travail importantes (100 journées à l'hectare) à une période de l'année ou l'offre est faible. Le sarclage mécanique n'est pas concevable sans plantation mécanique. De plus seul le sarclage de l'interligne ne peut être envisagé. Le Centre de Recherches s'est orienté avec succès vers le désherbage chimique en préemergence en faisant appel au CHU et aux Triazines, les adventices appartenant au genre <u>Trianthema</u>. Le désherbage chimique, pour un prix de revient inférieur entraîne une économie de main-d'oeuvre de 98 % par rapport au sarclage manuel.

L'irrigation des pépinières est rendue nécessaire par la faible pluviométrie. A la suite d'essais, l'irrigation par aspersion tend à se substituer à l'irrigation par gravité. Des études en cours visent à associer application des désherbants et des fumures minérales à l'aspersion.

d) <u>Densités et espacements</u> - Pour une densité donnée et comprise entre 4.000 et 6.000 plants/ha, la dissymétrie dans la disposition des plants (simples rangs à interlignes de 2 m et 2, 50 m ou double-rangs 4 m + 1 m) ne modifie pas les rendements. C'est donc en fonction des facilités d'entretien et d'exploitation qu'il convient de choisir l'espacement pour une densité donnée.

Les densités de 4.000 - 5.000 et 6.000 plants/ha montrent des différences de rendement hautement significatives, le meilleur rendement ha/cycle correspondant à la densité de 6.000 plants/ha.

e) Entretien des plantations - Il apparaît que l'entretien ne modifie pas significativement le rendement ha/cycle ; par contre la durée du cycle présente de grandes variations (5 ans à 8 ans½) pour les traitements expérimentés et un taux de fléchage uniforme de 60 %. Aussi l'intensification de l'entretien est-elle intéressante pour une exploitation de superficie limitée puisqu'elle permet d'augmenter de 25 % la production annuelle. En définitive l'entretien ne peut pas être considéré comme un facteur d'accroissement du rendement ha/cycle mais il intervient largement sur le rendement ha/an. Il permet de protéger le sisal contre la domination des adventices et de modifier le rythme d'exploitation en améliorant les facteurs de productivité coupe et défibrage. Son action sur les premières coupes est particulièrement nette.

f) Mode d'exploitation - La sévérité de la coupe à rythme annuel, dans les limites 13-39 feuilles laissées par plant est sans effet sur le rendement. Dans ces conditions une coupe sévère facilitant l'exploitation est à conseiller. Si l'on envisage seulement le rendement en fibre ha/cycle, il y a intérêt à accroître la densité jusqu'à 6.000 plants/ha ainsi que la précocité de la première coupe jusqu'à 2 ans½ aussi bien en alluvions qu'en sables roux.

Si l'on fait intervenir la rentabilité des traitements, le prix de revient cultural à la tonne de fibre (plantations + entretien + coupe) le plus bas est obtenu avec une densité de 6.000 plants/ha et une première coupe tardive. En définitive, la densité optima à conseiller est de 6.000 plants/ha en sables roux comme en alluvions. L'exploitation débutera lorsque les plants auront plus de 55 feuilles de 1 m et en attendant les résultats de l'essai sévérité-fréquence, l'on recommandera une exploitation tous les 10 mois laissant 15 feuilles sur pied.

3. Planning d'exploitation - Contrôle des rendements - La superficie à renouveler (x) chaque année dans une exploitation équilibrée est théoriquement le quotient de la production annuelle (P) par le rendement ha/cycle (R) :

$$x = \frac{P}{R}$$

Par ailleurs la valeur de x doit respecter la relation $x = \frac{X}{N}$ dans laquelle X est la superficie cultivable et N la durée du cycle cultural.

A l'aide de ces relations il est possible d'établir un planning d'exploitation précis. Lorsque des ajustements s'avèrent nécessaires, il est possible de faire varier N soit en modifiant la durée de la jachère entre 2 cycles, soit en agissant par des entretiens et des coupes judicieuses sur la durée du cycle de la plante. Pour des aménagements importants dans le planning l'on peut faire appel à la technique de la haute densité x coupe unique.

Le contrôle des rendements exécutés par le Centre a pour but de vérifier le rendement des défibreuses utilisées sur les exploitations, les pertes étant fonction non seulement du réglage des machines mais encore de la matière première traitée.

4. Choix d'Agave sisalana - Améliorations - Aucune espèce naturelle ou variété hybride ne s'est révélée jusqu'à présent supérieure au clone d'A. sisalana propagé en Afrique et à Madagascar. Toute amélioration de l'Agave sisalana suppose au préalable la création d'une variabilité à l'intérieur de l'espèce ainsi que l'obtention d'individus normalement fertiles. En effet la stérilité est la règle chez A. sisalana et la formation de fruits fertiles n'est constatée qu'exceptionnellement. Il convient d'ajouter que le caractère perenne de la plante avec apparition des organes fructifères seulement en fin de cycle constitue un handicap pour un programme d'améliorations.

CONCLUSIONS

Parmi les essais actuellement en cours, certains, comme les fumures minérales, doivent permettre de conclure rapidement sur la rentabilité de la fumure azotée.

L'évolution physique des sols et le niveau de fertilité sont suivis avec une attention toute particulière.

Le problème de l'entretien chimico-mécanique des plantations est encore à l'étude. Des résultats encourageants ont été obtenus, mais il est impossible de se prononcer dès à présent sur l'intérêt économique de la méthode.

Les relations eau-plante vont être serrées de plus près à partir d'études d'évapo-transpiration réalisées en cases lysimétriques.

Enfin, compte-tenu des résultats acquis sur le Centre de Recherches une fois atteint l'équilibre des exploitations, une production supérieure à 20.000 tonnes pourrait être escomptée dans la perspective d'une amélioration de l'offre d'emploi et de conditions de marché favorables.

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SUMMARY

Agenda Item: C.4.3

Madagascar

SISAL IN MADAGASCAR : PROBLEMS OF ITS CULTIVATION AND THE RESULTS OBTAINED BY THE MANDRARE SISAL RESEARCH CENTRE

By S. CRETENET,
Engineer, I.R.C.T.

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

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SISAL IN MADAGASCAR
PROBLEMS OF ITS CULTIVATION AND THE RESULTS OBTAINED BY THE MANDRARE SISAL RESEARCH CENTRE

By
S. Cretenet,
Engineer, I.R.C.T.

With the exception of the Morondava region where approximately 700 hectares are now devoted to the cultivation of sisal and there is every possibility of this figure being raised to approximately 3,000 hectares by the end of the sixties, sisal production is concentrated in the Mandrare Valley where 18,500 (and a probable future 20,000) hectares are devoted to its cultivation. In 1961 13,500 metric tons of sisal were produced and this figure may well reach 16,000 metric tons in 1962 and 18,000 metric tons in 1963 if labour continues to be available at the present rate.

In order to ensure further progress, the sisal industry (which plays a large part in the agricultural economy of Madagascar) must pay greater attention to intensified cultivation and the productivity of the labour force rather than to extending the areas under cultivation.

The I.R.C.T. Sisal Research Centre at Mandrare was set up in 1951 in order to study the problems created by the development of the sisal crop. The Centre had four main objectives:

- to study ecological data for the sisal areas;
- to analyse the production and productivity factors of the sisal industry;
- to solve the special problems which occur within the framework of a given rate of development;
- to study the possibility of conversion to some other type of crop in the event of the situation in the sisal industry becoming unfavourable.

As regards the first objective, the general soil surveys have been completed and a rain gauge network installed. Evapotranspirometric surveys are to be undertaken.

From the point of view of the Centre's second aim, important results have been obtained from experiments in the following fields:

Soil preparation

Vegetable matter for planting

Maintenance of nurseries

Density and spacing

Maintenance of plantations and method of operation.

Conclusions concerning non-organic manuring will be available in 1963; surveys of the physical evolution of the soil are now being conducted.

The Centre's third aim is to conduct special surveys concerning:

Planned operation

The supervision of material

The supervision of yields.

Finally, there is an irrigated plot which is being used for the study of the behaviour of fibrous plants and other crops in the Mandrare Valley.

In conclusion, the results obtained make it possible to envisage an increase in the sisal yield without calling for a corresponding increase of the area devoted to the product. A yield of 25,000 metric tons might well be hoped for once the balance of plantations reaches the stage at which the industrial potential can be brought to this figure and at which the labour required for this development is available.

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Point de l'ordre du jour : C. 4. 1

Haute-Volta

L'ARACHIDE : APPLICATION DES METHODES GENETIQUES A LA SELECTION DE VARIETES RESISTANTES A LA ROSETTE EN HAUTE-VOLTA

Par C. DANIEL,
Ingénieur Agricole,
Assistant Sélection à la Station IRHO,
Niangoloko

Les mémoires rédigés à l'intention de la Conférence des Nations Unies sur l'application de la science et de la technique dans l'intérêt des régions peu développées sont des documents de travail. Ils sont publiés tels qu'ils ont été présentés et les assertions et opinions qu'ils contiennent sont celles de leurs auteurs.

NOTES

1. Les mémoires choisis pour être présentés en séance générale pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.

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3. Les résumés qui ont été rédigés pour tous les mémoires par les auteurs de ceux-ci pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.

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APPLICATION DES METHODES GENETIQES A LA SELECTION DE VARIETES RESISTANTES A LA ROSETTE EN HAUTE-VOLTA

C. DANIEL
Ingénieur Agricole
Assistant Sélection à la Station I.R.H.O.de Niangoloko .

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1. a) Dans les conditions climatiques et écologiques de la Haute-Volta, les cultures d'Arachide sont assez peu sensibles tant aux attaques de parasites animaux qu'à celles de maladies fongiques ou bactériennes.

b) Par contre une maladie à virus," la Rosette",sévit d'une façon plus ou moins régulière,pouvant affecter certaines années des régions entières de l'Ouest du pays et réduisant les récoltes d'arachides dans de très fortes proportions.

c) Ayant admis que l'élimination de cette maladie était la condition première d'un développement de la culture de l'Arachide en Haute Volta, l'I.R.H.O., peu de temps après l'installation de sa Station Expérimentale de NIANGOLOKO, s'attaqua à ce problème.

d) Ce sont les premiers résultats de ces travaux et les perspectives qu'ils ouvrent qui sont brièvement exposés ici.

2. LA MALADIE DE LA ROSETTE

a) La maladie de la rosette de l'Arachide a été observée pour la première fois par ZIMMERMAN en Afrique Orientale en 1907.(a). Depuis, de très nombreux auteurs en ont donné des descriptions détaillées , différenciant d'ailleurs plusieurs formes de rosette selon le type de symptômes apparus.

b) La description ci-après correspond à la forme de maladie la plus courante en Haute-Volta: Il s'agit de la rosette chlorotique décrite par HAYES en 1932, et PORTERES et LEGLEU en 1933.

i) Lorsque la maladie apparait sur de jeunes pieds, leur croissance en est pertubée et leur aspect fortement modifié: réduction importante de la longueur des pétioles des feuilles et des entre-noeuds,ce qui donne à la plante un aspect en petite-touffe".

ii) D'autre part, les feuilles les plus jeunes deviennent plus ou moins chlorosées, jaune-pâle. Les nouvelles feuilles formées sont petites, enroulées, frisées, jaune-pâle avec des veines ou des marbrures vert foncé plus ou moins irrégulières.

iii) Un pied ainsi atteint en début de végétation peut donner naissance à quelques fleurs petites et sessiles qui ne produiront pas de gousses.

iv) Si la maladie s'attaque à un pied plus âgé, en pleine végétation, l'aspect rabougri et en touffe sera moins accentué, mais on retrouvera tous les symptômes sur feuilles, sur celles en formation au moment de l'attaque, et sur celles ayant poussé par la suite. Suivant la date plus ou moins tardive de l'attaque on peut obtenir une légère récolte.

v) La figure I montre l'influence sur la récolte de la date d'apparition de la rosette. Les résultats indiquent que la maladie apparaissant au cours des 3 premiers mois du cycle de l'Arachide, la production peut être réduite dans des proportions considérables pouvant aller d'une perte de 20 % jusqu'à une récolte quasi nulle .

vi) Des observations faites en 1937 par F.PANSE en Afrique Occidentale et plus particulièrement en Nord Côte d'Ivoire par PORTERES, et R.LEGLEU, ont montré que les pertes de rendement en gousses, du fait de la rosette, atteignaient 75 à 80 % de la récolte totale(b).

b) i) L'agent responsable de la maladie est un virus non encore isolé. C'est en 1926 que STOREY et BOTTOMLEY démontrent que l'agent vecteur de la maladie est un aphidien, Aphis leguminosae Theo, ou encore Aphis laburnii Kalt.

ii) D'observations ultérieures, il semble résulter que ce soit le seul agent qui puisse être mis en cause dans la transmission de la maladie. On connaît la biologie de ce puceron, étudiée par REAL. Sans entrer ici dans le détail de cette question, indiquons simplement que durant la saison sèche, les pucerons survivent en petit nombre sur diverses plantes hôtes, en particulier sur de nombreuses légumineuses sauvages. Les fortes pullulations sont liées, comme l'a montré REAL à l'hygrométrie relative minimum diurne qui doit atteindre 66 - 70 % pendant IO jours.

c) Connaissant les conditions de pullulations des pucerons et d'apparition de la maladie il est possible d'envisager différents moyens de lutte .

i) Il a été proposé d'établir des espaces dénudés, glacis, autour des champs d'arachides, ou au contraire une culture haute telle que Maïs, Mil : ainsi, les vents déposent les aphidiens, dont ils sont porteurs, avant la culture d'arachide.

ii) On possède en outre une gamme variée d'insecticides anti-aphidiens, tels les produits à base de malathion, de parathion

ou de démèthon-méthyl, ainsi que des insecticides systématiques qui auraient l'avantage sur les précédents d'avoir une plus grande rémanence. Ces procédés pour efficaces qu'ils soient, se révèlent d'un emploi coûteux et peu commode lorsqu'il s'agit de les appliquer à grande échelle chez les paysans et pour des cultures offrant malgré tout des revenus modestes.

iii) C'est pourquoi pour combattre cette maladie l'I.R.H.O., dès 1956, orienta ses recherches vers la solution génétique : création de variétés résistantes à la "Rosette".

3. VARIETES RESISTANTES A LA ROSETTE

a) i) En 1952, lors d'une attaque généralisée de rosette, II lignées sélectionnées par le Centre de la Recherche Agronomique de Bambey, Sénégal, et provenant de choix faits en 1948 à la Station Agricole de Ferkessédougou (Nord Côte d'Ivoire), ont été tolament épargnées par la maladie jusqu'en fin de végétation.

ii) Les tests de confirmation effectués par la suite ont montré que ces lignées étaient véritablement résistantes à la maladie. Il est à noter qu'il s'agit de résistance et non d'immunité. Ainsi les lignées et variétés résistantes mentionnées peuvent présenter, à l'occasion d'attaques particulièrement fortes (pullulation intense de pucerons, souche de pucerons fortement virosée), un certain nombre de pieds malades. Mais dans tous les cas le pourcentage de pieds malades se fixe aux alentours de 5 %, chiffre infime par rapport à celui obtenu avec les variétés sensibles, puisque par infestation artificielle, ces dernières présentent 100 % de pieds virosés.

iii) En 1956, 10 de ces variétés résistantes nous ont été remises par le C.R.A. de Bambey. Ces introductions permirent d'étudier leur comportement dans l'Ouest-Volta et servirent de lignées références lors des testages de résistance entrepris sur de nouvelles lignées en étude provenant des travaux de la Station de Niangoloko.

b) i) En 1956, furent effectuées de nouvelles prospections dans la région de Ferkessédougou. Un grand nombre de champs d'arachides tardives furent visités et dans ceux présentant de très forts pourcentages de pieds rosettés, les pieds demeurés sains en fin de cycle furent récoltés séparément : 174 pieds demeurés sains au milieu de tachés de rosette furent ainsi isolés.

ii) En 1957, ils donnèrent 174 lignées qui furent testées pour leur résistance.

a. Le testage est effectué en posant sur une feuille de chaque pied de la lignée en étude une petite cage en rhodoïd contenant une dizaine de pucerons porteurs de la maladie. Ceux-ci proviennent d'un élevage conduit en couches sur la Station durant toute l'année et dans lequel ils sont nourris de plantes de variétés sensibles.

b. De nouvelles couches sont semées périodiquement et la rosette apparaît en début de campagne sitôt que les conditions hygrométriques des couches sont favorables.

c. Quelques heures de contact entre un puceron porteur de la maladie et la plante suffisent pour que celle-ci contracte la rosette. En laissant les cages 24 heures en place, on travaille avec une très forte marge de sécurité.

d. La maladie apparaît sur des pieds non résistants I4 jours après l'apport des pucerons porteurs de virus.

e. Le contrôle de la virulence de la souche de pucerons utilisés se fait par infestation d'une variété sensible. Les infestations sont alors répétées tous les I8 ou 20 jours jusqu'à apparition de la maladie sur I00 % des pieds de cette variété sensible.

f. Lorsque les variétés sensibles témoins sont rosettées à I00 % on peut encore effectuer I ou 2 infestations de sécurité , à la suite desquelles, les pourcentages de pieds restés sains dans les lignées en étude déterminent leur degré de résistance.

iii) Le testage de I957 effectué sur les I74 lignées issues des pieds prospectés en I956, fit apparaître 20 lignées présentant moins de 20 % de pieds rosettés (3).

iv) Après nouvelles éliminations sur rendements en I958 de nombreux essais comparatifs ont été entrepris dès I959 avec le nouveau matériel résistant, ainsi obtenu en comparaison avec les variétés résistantes de Bambey et surtout des variétés locales bien adaptées à la région mais sensibles à la rosette.

c) i) Le tableau I indique quelques résultats obtenus durant les 3 dernières années.

ii) Ces chiffres illustrent les conclusions suivantes que l'on peut formuler quant à l'utilisation de variétés résistantes d' Arachide :

a. La réponse d'une fumure organo-minérale est meilleurs pour les variétés résistantes que pour la variété locale. On retrouve d'ailleurs ce résultat avec des fumures uniquement minérales.

b. Avec ou sans fumure, les variétés résistantes sont, dans tous les cas, supérieures à la variété locale, avec de plus la certitude d'une récolte égale à elle-même, quelle que soit l'intensité des attaques de rosette.

c. L'utilisation combinée d'une variété résistante avec une fumure organo-minérale, assure des rendements bruts en augmentation de I30 % par rapport à une culture d'arachide locale sans fumure.

d) i) Bien entendu les chiffres figurant dans le tableau I ne représentent que des rendements moyens et sont loin de correspondre aux maxima de production que l'on peut attendre de certaines variétés résistantes.

ii) C'est ainsi par exemple qu'en I960, la variété résistante I.R.H.O. I040 a obtenu un rendement brut de 3.I00 Kg de gousses/ha, la fumure était constituée par 5 Tonnes de fumier de ferme à l'hectare et I50 Kg. de superphosphate simple à I6 % de P_2O_5.

iii) En I96I, la même variété a donné à nouveau, en champs multiplication station, un rendement brut de 3.I00 Kg. de gousses à l'hectare en présence de 5 tonnes de fumier de ferme et I50 Kg. de superphosphate simple à I6 % de P_2O_5.

iv) Ces quelques chiffres montrent le potentiel de production que possèdent certaines variétés résistantes.

e) i) Connaissant les possibilités de production des variétés résistantes, la question se posait de savoir quelle était l'origine de cette résistance.

ii) Une étude faite en I957 (c) montra que les populations de pucerons étaient aussi denses sur les pieds des variétés résistantes que sur ceux des variétés sensibles. C'était dire que la résistance n'était pas due à un phénomène mécanique , par exemple épiderme plus dur chez les pieds résistants , et qu'on ne risquait pas ainsi, lors de la vulgarisation en grand des variétés résistantes, de voir peu à peu apparaître de nouvelles races de pucerons adaptées à ces épidermes coriaces .

iii) Les nombreuses observations faites depuis accréditent de plus en plus l'hypothèse de la production par les variétés résistantes d'une substance antivirus.

f) A la suite de ces résultats, la vulgarisation des variétés résistantes a été entreprise et leur emploi par les cultivateurs, associé à des améliorations culturales, telles que désinfection des semences, semis dense, bon entretien des cultures, assure en milieu villageois de belles productions.

4. ETUDE GENETIQUE DU CARACTERE RESISTANCE A LA ROSETTE

a) Concurremment à l'étude de ces variétés résistantes issues de prospections, dès I956 l'I.R.H.O. démarra un programme d'hybridations qui, outre la recherche d'hybrides bien adaptés, résistants et toujours plus productifs, a permis dès I959 de déterminer le mode de transmission du caractère résistance à la Rosette (d).

b) Les F2 ou 2ème génération des hybrides faits en I956, I957 et I959 ont été systématiquement infestées et, pour 2925 pieds observés,

il y en eût :

I83 sains
et 2742 malades.

c) On formule l'hypothèse suivante : La transmission du caractère résistance à la rosette est un cas de dihybridisme commandé par 2 gènes homomères à dominance totale, la résistance étant donnée par le double recessif. Si cette hypothèse est exacte, la disjonction trouvée doit correspondre au type I5-1 : en F2, I5 individus malades soit 93,75 % pour I individu sain soit 6,25 %.

d) Suite aux résultats observés, l'étude du critérium X^2 de PEARSON donne :(Tableau 2) pour degré de liberté, avec un coefficient de sécurité de 95 %, la valeur limite du X^2 correspondant aux fluctuations du hasard est de 3,84. Avec la valeur trouvée de 0,0002I, on peut conclure que les fréquences observées sont strictement conformes à ce que l'on pouvait attendre d'une disjonction de type I5-I. Notons à ce sujet que l'Arachide se comporte ici comme un simple diploide, ce qui ne semble pas être le cas pour d'autres caractères, tel le port, par exemple.

e) Le caractère sensibilité à la rosette étant un dominant strict, il s'ensuit que les F1 d'hybrides sont entièrement sensibles, remarque qui a son importance pour la conduite des programmes d'hybridations. Soit A et B les 2 gènes : la sensibilité apparaîtra lorsque le phénotype contiendra AB ou seulement A ou B. La résistance correspondra au double récessif aabb. La F1 d'un croisement d'une varié té sensible par une variété résistante, considérées comme homozygotes, possèdera le génotype AaBb et sera donc I00 % sensible.

AABB	x	aabb		AaBb
Variété sensible	x	Variété résistante	--→ F1	I00 % sensible

5. HYBRIDATIONS REALISEES A PARTIR DE CES VARIETES RESISTANTES

a) L'I.R.H.O. ayant atteint le premier objectif qu'il s'était fixé, à savoir : fourniture aux paysans de semences de variétés d'arachides résistantes à la rosette et bien adaptées à la région, résultat acquis dès I959 et sur lequel fut basée l'action de vulgarisation auprès des paysans, le second stade du travail d'amélioration de la plante fut entrepris : utilisation des variétés résistantes pour la création d'hybrides.

b) i) Ce travail commença dès I956 par un programme d'hybridations simples entre variétés résistantes et un certain nombre de variétés locales ou étrangères sensibles mais intéressantes pour d'autres caractères.

ii) Puis en I959, à la lumière des premiers résultats de ces hybridations, les programmes furent poursuivis en utilisant la méthode des croisements de retour, ou Back-Cross.

c) Les principaux types de croisements effectués en I956 et I957 avaient pour but :

i) Création de variétés résistantes encore mieux adaptées à la région d'où croisements entre lignées résistantes de Bambey et variétés locales de Niangoloko à bonnes caractéristiques de gousses et de graines.

ii) Obtention de variétés résistantes à grosses gousses:croisements entre lignées résistantes de Bambey et Arachides de bouche type US.

iii) Création de variétés résistantes à cycle court: Croisements de variétés résistantes par variétés hâtives .

d) Les hybridations s'effectuent sans difficulté spéciale en utilisant les méthodes décrites par SAUGER(e) ou BOLHUIS(f): Castration des fleurs à partir de I6 heures et fécondation le lendemain matin vers 6 heures. Les pourcentages de réussite varient suivant les saisons entre 25 et 45 %. Les F1 de tous ces croisements,étant comme nous l'avons vu,sensibles à I00 %, doivent être cultivées en serre à l'abri de toute invasion de pucerons. Les F2 sont semées en lignées en champs et il est pratiqué sur eux des infestations systématiques par le même procédé décrit ci-dessus , afin de déceler les pieds résistants. Ils apparaissent dans la proportion de 1 pied sain pour I5 pieds malades. Ce sont avec ces pieds F2 résistantsqu'est poursuivie la sélection en lignées. Dès la F4 de ces croisements de I956 et I957, un certain nombre de lignées se sont révélées homogènes, tout au moins pour tous les caractères observables.

e) i) Un premier choix fait EN I96I retint 8 hybrides en F5 pour figurer dans un essai comparatif avec leurs parents,ainsi que les meilleures variétés résistantes.

ii) Dès la première année d'étude comparative, des résultats intéressants ont été obtenus,puisque des hybrides ont avoisiné les 2.500 kg. de gousses à l'hectare.

iii) En I962 et dans les années suivantes d'autres choix seront faits, de nouveaux hybrides homogènes seront retenus et les essais comparatifs seront poursuivis.

iv) D'autres parts des sélections généalogiques sont entamées en I962 avec le matériel poursuivant ses disjonctions.

f) i) Dès I959 il apparût que le caractère hâtivité, c'est-à-dire caractère d'une arachide effectuant son cycle en 90 jours, ne réapparaissait jamais dans les descendances hybrides provenant de croisements variétés hâtives par variétés tardives. En fait on a bien trouvé quelques hybrides à cycle plus court mais ceux-ci étaient toujours d'au moins I25 jours. Pensant que la transmission de ce caractère était régie par de nombreux gènes, il a été décidé de démarrer un vaste programme d'hybridations par Back-Cross, afin d'accélérer au maximum la réunion sur un même hybride du caractère résistance et du caractère hâtivité. Les deux variétés utilisées pour ces travaux ont été :

a.1 variété résistante tardive comme parent non récurrent.

b.1 variété hâtive sensible comme parent récurrent.

ii) Les premiers Back-Cross ont été effectués en I959 sur les F3 d'dybrides variétés résistantes x variétés hâtives.

iii)La F2 issue de ce premier croisement de retour a été testée pour le caractère résistance à la rosette. La F3 des pieds résistants ainsi décelés a servi de parent pour un deuxième Back-Cross.

iv) A chaque génération F2 les types de floraison et cycles de tous les pieds sont analysés.

v) 5 ou 6 Back-Cross seront sans doute nécessaires pour obtenir l'hybride hâtif résistant recherché.

g) Depuis I962 on utilise également la technique du Back-Cross dans d'autres types de croisements, en particulier dans ceux utilisant comme parents des variétés tardives résistantes et des variétés hâtives sensibles mais présentant d'autres caractéristiques intéressantes, telle la Roxo II, variété hâtive originaire du Brésil qui possède des gousses trigraines. C'est la variété hâtive, ici la Roxo II, qui servira de parent récurrent.

h) Nous n'avons bien entendu donné ici qu'un aperçu des différents travaux d'hybridation que permet le matériel résistant en notre possession.

6. CONCLUSIONS

a) Dans l'Ouest de la Haute-Volta la culture de l'arachide n'avait aucun avenir, les récoltes étant aléatoires par suite d'une maladie à virus, la Rosette de l'Arachide sévissant à l'état endémique.

b) La sélection de variétés, résistantes à la Rosette et bien adaptées aux conditions de la région,a déjà permis aux cultivateurs encadrés dans les secteurs de Vulgarisation de l'I.R.H.O. de profiter à coup sûr tous les ans, quelle que soit la virulence des attaques de rosette , des récoltes de l'ordre de I.700 à 2.000 Kg. de gousses à l'hectare, toutes les autres conditions de semis, de fumure, et d'entretien étant évidemment satisfaites.

c) De plus ces variétés résistantes servent et serviront de plus en plus de base pour des programmes d'hybridations pour la recherche d'hybrides résistants à la rosette et présentant d'autres caractéristiques intéressantes, comme par exemple la hâtivité. De tels hybrides auraient un intérêt certain pour les cultivateurs du Nord de la Haute-Volta.

d) Ainsi les travaux de sélection ou d'hybridations entrepris sur des variétés d'Arachide résistantes à la rosette par la Station Expérimentale I.R.H.O. de Niangoloko ont eu ou auront leur application directe en culture paysanne pour le plus grand profit du cultivateur voltaïque.

TABLEAU 1

Résultats d'Essais Comparatifs

VARIETES \ ANNEES		1959	1960	1961	Moyenne 3ans
Résistantes I.R.H.O.	Avec fumure (a)	2011(b)	2369	2530	(2387)
	Sans fumure	937	1419	1246	1200
	Effet fumure (c)	114 %	66 %	103%	98 %
Résistantes Bambey	Avec fumure	1820	2532	2467	2273
	Sans fumure	883	1354	1345	1194
	Effet fumure	106 %	87 %	83%	90 %
Variétés locales sensibles	Avec fumure	1448	1853	1797	1699
	Sans fumure	733	1148	-	(940 d
	Effet fumure	97 %	61 %	-	80% (d)
Augmentation de rendement dû à l'emploi d'une résistante I.R.H.O.(e)	Avec fumure	38 %	27 %	-	32% (d)
	Sans fumure	27 %	23 %	-	25% (d)
Effet combiné de l'emploi d'une variété résistante et de la fumure (f)		174 %	106 %		(132)%(d)

TABLEAU 1 : Résultats d'Essais comparatifs.

(a) - Fumure organo-minérale : 5 tonnes de fumier ferme et 75 kg. de superphosphate simple à l'hectare.
(b) - Rendements bruts en kg. de gousses à l'hectare.
(c) - Effet de la fumure exprimé en pour cent du témoin non fumé.
(d) - Résultats des 2 années 1959 et 1960.
(e) - Augmentation de rendements en pour cent du rendement de la variété locale.
(f) - Effet de l'emploi combiné d'une variété résistante et d'une fumure organo-minérale exprimée en pour cent du rendement de la variété locale sans fumure.

- Résistantes I.R.H.O. : les 3 variétés 1036, 1037, 1040.
- Résistantes Bambey : les 2 variétés 48-36, 48-37.
- Locale sensible : Rose de Niangoloko.

TABLEAU 2

	Nombres observés (a)	Nombres théoriques (c)	$X^2 = \frac{(a-c)^2}{c}$
Pieds sains	I83	I82,8I	0,000.I97
Pieds malades	2742	2742,I8	0,000.0I3
Total	2925	2924,99	0,000.2I0

X^2 = 0,000.2I . Nombres de degrés de liberté = I.

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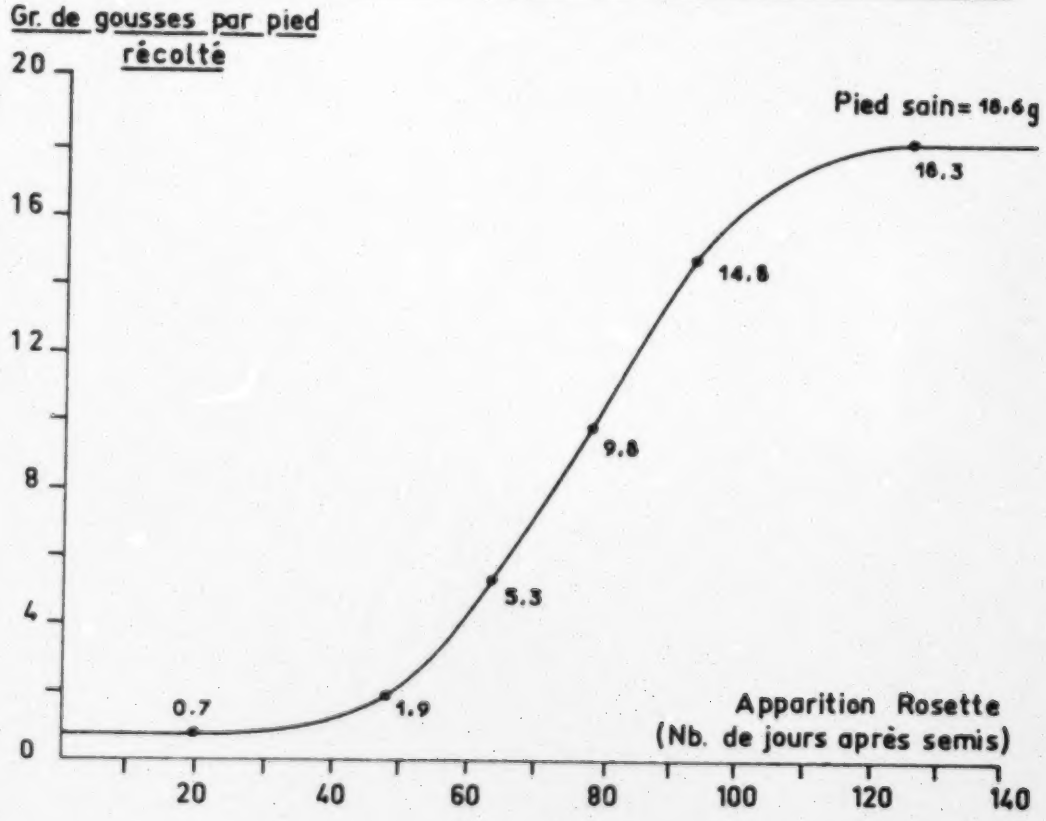
f - BOLHUIS - Oléagineux, Juin I954

INFLUENCE DE LA DATE D'APPARITION DE LA ROSETTE SUR LES RENDEMENTS EN GRAMMES DE GOUSSES PAR PIED



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SUMMARY

Agenda Item: C.4.1

Upper Volta

THE GROUNDNUT : INTRODUCTION OF GENETIC SELECTION METHODS OF ROSETTE-RESISTANT STRAINS IN UPPER VOLTA

By C. DANIEL,
Agricultural Engineer,
Selection Assistant at the I.R.H.O. Station,
Niamgoloko

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THE GROUNDNUT:
INTRODUCTION OF GENETIC SELECTION METHODS OF ROSETTE-RESISTANT STRAINS IN UPPER VOLTA

By:
C. Daniel,
Agricultural Engineer,
Selection Assistant at the I.R.H.O.
Station, Niamgoloko.

1. (a) A virus disease known as "Rosette", endemic in the western region of Upper Volta, caused such havoc to the groundnut crops that the peasants have well-nigh abandoned cultivation of the latter.

(b) An essential prerequisite to any development of the groundnut crop in the area was the search for some means of combating the disease. This problem was tackled by the I.R.H.O. Station at Niangoloko in 1956.

2. The "Rosette" Disease.

(a) Since 1907, when rosette was described for the first time by ZIMMERMAN, it has been observed by many other authors in all regions of West and East Africa.

(b) The symptoms of chlorotic rosette, the form of the disease occurring most frequently in the Haute Volta, may be summarised as follows:

(i) Chlorosis of the new leaves which turn pale yellow.
(ii) Marked decrease in the length of the leaf stalks and of the internodes giving the plant a "tufted" appearance.
(iii) When the new leaves appear they are very small, curled, folded over and chlorotic, with dark green stripes or veins.
(iv) The yield may fall by 95 - 100 %.

(c) The vector of the disease is an aphis, the Aphis leguminosae Theo. One method of combating the disease might be the destruction of this aphis by a suitable insecticide.

(d) However, the I.R.H.O. opted for a solution which would prove more economical for the farmers of the Volta, namely the provision of seeds of selected rosette-resistant strains.

3. Rosette-Resistant strains

(a) In 1956, surveys carried out in fields of local groundnut plants suffering considerably from rosette made it possible to select some plants which had remained unaffected.

(b) Testing of the resistance of descendants of these plants revealed that some of the new varieties thus created did in fact possess a resistance to rosette, and that this resistance was transmitted unimpaired from one generation of plants to the next. It was not simply a question of a mechanical phenomenon (i.e. a harder and therefore less punctured surface in the resistant strains). It was therefore certain that there would be no weakening of the resistance through adaptation by new strains of aphids.

(c) The studies carried out with these varieties established by selection have revealed the advantages to be derived from their use:

(i) However serious the attack, only about 5% of resistant plants are affected, whereas the proportion of sensitive local varieties affected may even be 100 %. Thus, the resistant variety ensures an intact crop, however virulent the rosette disease may be.

(ii) In all cases, the yield of resistant plants is always higher than that from the local variety: the average for the results over the space of three years gives a figure of 2,400 kg. as compared with 1,700 kg. for a local variety. The potential yield exceeds 3,000 kg.

(iii) The response to organic and chemical manuring (5 tons of farmyard manure and 75 kg. of plain superphosphate per hectare) is better in the case of the resistant varieties.

(iv) Moreover, the use of a resistant variety with manure gives an increase in yield of 130 %, as compared with that from a local variety without manure.

(d) These early results were made known to the peasants from 1960 onwards.

4. Genetic study of the nature of the resistance

(a) The second generation of hybrids obtained from resistant and early varieties were systematically infested with disease-carrying aphis. It was thus possible to control the number of resistant plants and so to deduce the mechanism of transmission of the resistance itself.

(b) It is a question of bihybridism which prevails entirely with a homomer gene; the F2 assortments correspond to the 15-1 type: 15 sensitive plants to 1 resistant plant. The "resistant" character is carried by the recessive double.

5. Hybridisation using resistant varieties

(a) The purpose of the various hybridisation programmes undertaken at the Station was to combine in the same hybrid both resistance to rosette and other desired characteristics such as high yield, large shells and earliness.

(b) Hybrid varieties were given comparative trials in 1961 and the results appear promising. Many genealogical selections were made with the most interesting of those following their assortments.

(c) The feature of earliness (a 90-day period) has never been known to occur naturally in association with resistance to disease.

(d) In an effort to combine these two features in the same hybrid, several back-crossing programmes were undertaken from 1959 onwards.

(e) The recurring parent is then the early variety, and at each F2 generation, the resistance of all plants is tested in order to select those which are resistant (these would seem to be in the ratio of 1:16) so that back crossing can be continued with these.

6. Conclusion

(a) The generalised use of resistant varieties coupled with organic and chemical or even simply chemical manuring has already enabled progressive cultivators to more than double their groundnut crop.

(b) The hybridisation which is now being carried on using resistant varieties give some hope of achieving a resistant hybrid which will also possess other desired characteristics: better yield, good shell quality, shorter growing cycle.

(c) It will always be possible to implement the achievements very quickly in a peasant community for the benefit of the Volta farmer.

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